Effects of geothermal usage on shallow aerobic aquifer systems - temporarily increase in abundance and activity of sulfate reducing bacteria

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The technical and environmental aspects of geothermal energy storage in the subsurface have rarely been studied. Particularly, the impact on the aquifer colonizing microorganisms is insufficiently investigated. Soil column experiments at four different temperatures (10 °C, 25 °C, 40 °C, 70 °C) were carried out to simulate a temperature elevation in aerobic shallow aquifers due to geothermal usage of the subsurface. The columns were filled with Pleistocene aquifer sediment and flown through with tap water containing approximately 5 mg L^{-1} oxygen and 0.5 mmol L^{-1} sulfate. In addition to geochemical analyses, the microbial community composition and abundance in the upper outflow fluids were analysed by genetic fingerprinting and quantitative polymerase chain reaction. After an initial phase at a groundwater temperature of 10 °C, one column was kept at 10 °C as a reference and the other three columns were heated to 25 °C, 40 °C and 70 °C. The bacterial community composition as well as abundance changed in terms of the temperature increase. While the geochemical composition and gene copy numbers for *Bacteria* only changed slighly at 25 °C, increasing concentrations of total organic carbon in the 40 °C column were followed by a strong increase in bacterial abundance. Thermophilic bacteria appeared after 50 days of heating at 70 °C. Interestingly, a temporarily sulfate reduction took place at 70 °C and this correlated with an increased abundance of sulfate reducing bacteria. The results indicated that a temperature increase up to 70 °C in aerobic shallow aquifers caused by geothermal usage might enhance the activity of sulfate reducing bacteria leadingto a possible production of hydrogen sulfide in the groundwater.